

The Role of Environmental Pollution of Pesticides in Human Diabetes

Sara Mostafalou and Mohammad Abdollahi

Faculty of Pharmacy and Pharmaceutical Sciences Research Center,
Tehran University of Medical Sciences, Tehran, Iran

When talking about diabetes risk factors, first of all rich diet, sedentary lifestyle and family history come to mind, but proof on the role of environmental contaminants particularly pesticides in diabetes is rising.

Pesticides have been utilized by humans to protect crops since before 2000 BC. Elemental sulfur dusting was the first recognized pesticides until 15th century when heavy metals were introduced. During 17th and 19th centuries, some natural compounds like nicotine, pyrethrum and rotenone were applied to kill pests. It was since 1950 that organic insecticides including organochlorines, organophosphates, carbamates and various herbicides started to be synthesized and used widely so that more than 1,055 active ingredients are registered as pesticides currently. The world pesticide use was approximated around 5.2 billion pounds in 2006 and 2008 that means their usage has increased 50-fold during the past 50 years (Miller, 2002; <http://www.epa.gov/opp00001/pestsales/07pestsales/ma>).

Pesticides are highly settled in today's world so that, from the public health standpoint, their usage is not an option anymore but a must. Without utilization of pesticides against vectors of diseases and pests, the destructive effects on human and animal health and also economic loss would be huge. Rise of food price, world hunger and loss of jobs are some results of not using pesticides and that's why the world is greatly benefited from them. Nevertheless, pesticides are major contributors to environmental pollution and their adverse health effects on living systems are too big to close eyes to (Abdollahi *et al.*, 2004).

Recent scientific research revealed that exposure to pesticides causes a wide variety of human health problems which among them some metabolic disorders like diabetes recognized as one of the global major public health problems. To date, growing body of data is collected from various animal and human studies that implies on the association of pesticides exposure with diabetes (<http://tums.isna.ir/Default.aspx?NSID=5&SSLID=46&NID=7271>; Rahimi and Abdollahi, 2007).

Since, 10 years ago, the number of people with diabetes has more than doubled to 285 million and it is,

moreover, increasing most rapidly specially in developing countries. Diabetes isn't pointed as a disease of the idle rich or sedentary middle-class any longer and it has even become largely a disease of poverty in developed countries (Tuchman, 2009). Acknowledging the higher incidence of diabetes and negative effects resulting from it like chronic complications and socioeconomic detriments and considering the increased evidence on the association of this disease with exposure to pesticides, investigating the potential mechanisms by which pesticides as an unavoidable part of the ecosystem induce or develop diabetes has been valuable more than ever.

Generally speaking, diabetes is the disease of defect in insulin secretion or responsiveness. Multiple mechanisms by which pesticides can disrupt the release of insulin or decrease the tissues' response to insulin have been proposed like oxidative/nitrosative stress, inflammatory pathway, mitochondrial dysfunction and proxisome alteration. Likewise, in some cases their main mechanism of toxicity or the type of target organ take steps in benefit of developing this disorder, like perturbation of insulin secretion by organophosphates in pancreatic islets via cholinesterase inhibition or decreasing metabolic activity of adipocytes by organochlorines as the most lipophilic pesticides which accumulate in adipose tissues. Moreover, exposure to pesticides as a stress situation threatening homeostasis causes alterations in body's defend axis like immune-neuroendocrine and autonomic nervous system in favor of hyperglycemia (Karami-Mohajeri and Abdollahi, 2011; Mostafalou *et al.*, 2011).

However, much is known about the contribution of exposure to pesticides with diabetes and it is no secret that the issue is going to be one of the global health dilemmas, so it needs to be thought decisively.

Although, our understanding of whether and how preventive approaches could be achieved is still incomplete, but there is some good news of efficacy of compounds like antioxidants, phosphodiesterase inhibitors and bioscavengers as prophylactic agents (Rahimi *et al.*, 2005; Hosseini and Abdollahi, 2012). Besides finding

suitable endpoints to evaluate mechanistic pathways, the importance of clinically accepted measures of diabetes in link with pesticides should not be forgotten.

As known, the mark of good science is provoking new research directions, so reducing the gap between environmental toxicologists and pesticides formulators might help to meet new approaches in lowering the metabolic disrupting effects of pesticides.

At the core, health promotion in this respect requires a shift in thinking and action by regulatory agencies in order to run more safety tests before introducing a new pesticide to the market.

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